The Science Teacher

(See Page 4) Science Service

Published Quarterly

October
December
February
April

A National Service Journal

The Science Teacher

VOLUME VII | FEBRUARY, 1940 | NUMBER 1

A Program of School Health Education

EARL E. KLEINSCHMIDT*

Loyola University School of Medicine — Chicago, Illinois

This article is the first of a series in the field of health education which is to appear regularly in *The Science Teacher.*—The Editor.

"The first care of education should be the preservation and improvement of health. School hygiene in the past has been too largely concerned with the child's environment and the external conditions affecting his health such as the school building, its sanitary features, and the sources of infectious disease. These factors should not be neglected, but the pupil with his own personal status and problems should be understood, and his adjustment to the environment of school and his life outside should be more carefully considered. School hygiene should be responsible for all the phases of education directly related to health. These various interests—some already provided for in part, and many others as yet neglected—should be unified and co-ordinated as much as may be necessary for the effective attainment of health results and economic school administration."[1]

THIS STATEMENT might very well apply to the present situation in many schools as regards their program of school health education; but as it happens, it was made in 1903 by Dr. Thomas D. Wood, a pioneer in the field of school health. Even at that early date apparently, need for greater unity of effort on the part of health-contributing agencies in the schools was recognized. Since then many other school health authorities have seen fit to comment likewise.

During the entire period that public and private schools in the United States have been interested in the improvement of health conditions, there have been added to the school curriculum, singly and independently, such health-contributing agencies as physical education, athletics, home economics, medical inspection, school nursing, dental service, mental-hygiene clinics, pre-school clinics, open-air classes, classes for the deaf and hard-of-hearing, orthopoedic classes, visiting teachers, speech-correction classes, recreation, corrective gymnastics, health instruction, biology, school sanitation, and nutrition. In the process of adding these activities there has been much overlapping of responsibility, uncertainty as to the functions of each representative interest, a tendency for each department or individual to operate independently of the others, and emphasis placed most commonly on a "program" or "course" rather than on **an integrated program** which contributed to the improvement of child health. This situation prevails quite generally today.

AWARE OF the growing complexity of this problem, many school administrators are seeking methods which will ultimately lead to better co-ordination of function, and which in turn will enable each part to perform its own special functions, and at the same time assist every other division and subdivision of the total school health program in the performance of their special functions. The subject is one of timely importance, and accordingly deserves extended discussion. It will be the purpose of this article, therefore, (1) to call attention to the importance of this situation, and (2) to set forth briefly a few guiding principles which, it is hoped, will serve to assist the school administrator seeking a better integrated program.

Generally speaking, up until comparatively recent times, responsibility

* Earl E. Kleinschmidt, M.D., Ph.D., is Associate Professor of Public Health and Preventive Medicine, and Chairman, Department of Preventive Medicine, Public Health, and Bacteriology, Loyola University.

for health work in the secondary schools was delegated to most anyone of the regular teaching staff who, either by inclination or by reason of training in biology, aspired to a higher lever in the scholastic order of things as an authority on health. High schools have attempted to carry on quasi-health work in the nature of cursory medical inspection at irregular intervals, the teaching of courses in physiology, general science, biology, home economics, and hygiene, and in providing for certain machineries regarded as health practices, chiefly physical exercise and recreation. Scarcely any attention was given to the training of teachers in the health field until comparatively recent years, or was much thought given to the relationship of health education, or 'hygiene' as it was more commonly designated, to the entire educational program.

IN THE MAIN, four major movements are discernable as composite parts of the total school health program found in the modern city school system: (1) formal physical education; (2) informal physical education; (3) school health service, and (4) health instruction. Let us consider each in turn.

EACH OF THESE four representative health-contributing agencies in the schools now claims for itself a portion of the child's day while in school. Every state now has on its statute books laws governing the number of minutes which children shall devote each week to physical education. In forty states there are laws concerning medical inspection ranging from provisions for annual inspection of hearing and vision to a complete physical examination. Some states compel vaccination of children against smallpox; others not. Representatives of temperance organizations still insist that their program be incorporated within the school curriculum. Dairy associations propagandize school teachers in an effort to get children to drink more milk, and so on. One might continue at great length to illustrate the point, that the presen day school health education program is the composite of efforts by zealous pressure groups, each of which have made piecemeal contributions to the improvement of child health. In the writer's estimation, schools need to make some concerted effort to evaluate their health programs in terms of their total effect on the child where such conditions still exist. Instead of several health programs, there is needed one single, integrated health program in every school system which has its beginning in the kindergarten and continues through graduation from high school.

Adjusting the Health Program to the "Whole" Child

THE BEST WAY for the school administrator to adjust his thinking to the modern viewpoint in school health education would be to dissociate himself entirely from all previously held concepts of the school's health program as described previously and substitute in their place the basic philosophy of health education laid down at the White House Conference on Child Health and Protection of 1930. Certainly no better set of principles have been advanced since this memorable meeting. Other significant guideposts to consider might be the several conference reports of the now defunct American Child Health Association.

Without especial training in the field of school health education, it becomes rather difficult to obtain an understanding of the "wholeness" of the present day school health education program. However, lacking this, the school administrator should have access to professional health workers on whom he can rely for sound advice. These should be school men in every sense of the word, persons well-trained in the health-medical sciences, and educational as well. Otherwise, the administrative policies of the superintendent will be conditioned as in the past by the advice of persons having a sentimental or amateur basis for their opinions.. and there are an abundance of amateur or pseudo-health advisors in every school system. Seldom is a subject spoken of with more authority.

FUNDAMENTALLY, the activities included in a school health education program should be determined by and built in accordance with the biological basis of health. This, the school administrator should bear in mind regardless of how extensive a program he is aiming to develop. The health and life of every living organism, whether a one-celled protozoan or a growing, active child, is a product of three determining biological factors: (1) a favorable health heritage with particular reference to constitutional qualities of health, resistance to disease, and organic defects leading to physical and mental disability. This we shall refer to as the **genotype**; (2) a favorable environment with particular reference to the body's relation to air, water, foods, poisons, parasites, light, exercise, rest, the sociosphere, mechanical hazards, sunlight, focal infections, narcotics, stimulants, etc. (to be referred to as constituting the **paratype)**; and (3) a favorable interaction or reaction between these two aforementioned factors which should result in the development of a well-integrated or realized individual whom we will call the **phenotype.** The health of every child is dependent on these three factors and their proper integration. Similarly, every school health education program must be geared to allow for adequate recognition of these factors in terms of their total effect on the child as a whole.

For the school to continue to emphasize one or two health-conditioning factors to the exclusion of others equally as essential to child health is to ignore the lessons which the sciences of biology, medicine, psychology, and sociology have taught us in recent years. Thus, for example, a program which takes account of the physiological need of a child for exercise, but which excludes or ignores the fact that this same child is possibly unable to profit from the experience because of, let us say, a secondary anemia, would fail utterly to bring health or "wholeness" to that particular child. It might, as a matter of fact, result in the direct opposite, illness. The same result might accrue to children whose parents and teachers ignored the necessity of their having protective foods in their diet, but insisted on their obtaining a maximum of sleep.

Requisites for an Integrated Program

WHILE IT WOULD be difficult in so short a discourse to do adequate justice to this subject, it may suffice to call attention to a plan of organization which stresses the essential points in need of emphasis (see figure 1). In addition, the following brief comments are offered by way of explanation:

1. **Common Objectives.** The school health education program should be built on the basis of common objectives to which all school personnel subscribe. A health creed or philosophy of health education is also a basic need; its purpose being to lead each health worker to work toward a common end, the promotion of child health.

2. **Appreciation for "Wholeness" of Program.** No better plan is available for developing an appreciation for the "wholeness" of the program than an alert health council. This group, consisting of administrators, teachers, parents, and health specialties, have as their function the general problem of co-ordination of the entire program. It should act primarily as a steering committee or clearing house for group thinking on the subject. Other subcommittees, as indicated, serve to expedite the work of the council.

3. **Balanced Program.** Essentially, a school health education program consists of a triad of three well-defined, yet functionally related interests and activities: 1. Health service; 2. Health instruction, and 3. Healthful school living. This program should be closely coordinated with the contributions to health improvement made by teachers of general science, biology, chemistry, and physical education. The health program at the secondary level should also be closely related to the community health program.

4. **Strong Leadership.** Responsibility for the administration of the school health education program should rest with an assistant-superintendent, a director of school health education whose function is to put into practice the recommendations of the school health

(Continued on page 18)

THE SCIENCE TEACHER

201 North School Street, Normal, Illinois

A National Journal Serving State and Regional Associations

Subscription rates: In the United States, $1.00 per year, or $1.75 for two years; in Canada, $1.25 per year, or $2.00 for two years. THE SCIENCE TEACHER is published quarterly during the school year.

ENRICHENING MATERIAL CO-OPERATIVE PROJECT

The enrichening material project sponsored by The Science Teacher appears to be moving forward quite well. It now includes analytical reference lists, film lists, and sources of free and nearly free materials. In the section dealing with analytical references for both biology and chemistry a large number of teachers in widely distributed areas have freely offered their services in compiling the material. With more time now available at the beginning of the second semester, most of the work should soon be completed.

We certainly appreciate the hearty co-operation given on the part of many busy teachers. We believe work of this type is stimulating in the direction of professional growth and often leads to the establishment of valuable contacts.

Further, we have been much encouraged by teacher reaction in regard to enrichening material. A number of teachers have expressed themselves as believing this to be a worthwhile project. Some urge that the work be extended to include all the sciences. Evidently it provides a service that live teachers need and want.

PROBLEM SOLVING

For those who are interested in new procedures in making science function in life situations we would call attention to the current article in this issue written by Professor R. W. Fogler of Illinois State Normal university and the article to follow. He has well demonstrated in his work with students in high school chemistry that students can attain a scientific consumer approach to the buying of goods.

OUR FRONTISPIECE

The photograph is by Fremont Davis and shows "light that bends around corners." New transparent water-clear plastics from coal, air, and water, possess the ability to direct light through curved tubes by internal reflection . Among the many applications are lighting devices to reach spots in dental and general surgery that are difficult to reach

Science Must Serve Our Youth

FRANK GRAHAM

Ball State Teachers College — Muncie, Indiana

THE RECENT trends in educational thinking make it imperative that science teachers give critical thought to the subject matter given in science courses. Up to the present, subject matter has been taken from what has become traditional in previous courses. Now that functional material is demanded, considerable reorganization is needed. Selection of material and the plan of presentation will necessarily depend on the needs of students.

There are two groups of students to be served, one an ever-increasing group who will attend some college or university, the other composed of those who from preference or necessity must obtain jobs after completing the high school course. Each of these groups must live in a society of which they are a part and which they should make better for having lived in it. Each will meet certain problems and situations either from choice or from necessity. Some of these problems and situations as listed by Professor Samuel Ralph Powers of Teachers College, Columbia University, are (1) the contacts of the home and the family into which each is born and the one which each may desire to establish; (2) the problems of our economic and governmental systems and their solution; (3) the improvement of the instrumentalities of education, such as the school, the press, the radio, and the movies; and (4) in this rapidly moving world there arises an extreme need for the preservation of physical and mental health.

To meet their problems, each group of students must have (1) some amount of specific information and specific skills that are usable in everyday life, (2) some generalized insights concerning such points as heredity, the place of the family in society and intellectual integrity, (3) methods of thinking that are sound and critical, (4) an appreciation and respect for objective evidence and integrity, and (5) an intelligent and workable philosophy for living in a modern world and a democratic society.

AS A RESULT of the Regents Inquiry into the Character and Cost of Public Education in New York State, conclusions were reached which state that boys and girls now need a broad general education which gives some minimum essential tools of intercommunication and thinking, some minimum up-to-date scientific acquaintance with the world in which we live, an appreciation of the culture and standards of our civilization, the beginnings of the ability to work with others, a common understanding and belief in democratic processes, and the desire to preserve and defend self-government. They further conclude that vocational training in this American system should give a good general knowledge which underlies a family of occupations, that is, an understanding of the scientific facts and economics lying back of these trades, an ability and character to work effectively with others, and an appreciation of the way changes come and how one may best adjust oneself to these changes. In addition to this and coming at the end of his training, just before he has a real chance of getting a job, one needs an immediately marketable skill. When one with such training gets a job he will be equipped to acquire the necessary particular skills and knowledge on the job as a learner. In some fields he may even return to school for special courses organized in co-operation with labor and industry.

Since more students need to be drawn into science classes, it is suggested that we make science more popular with those now enrolled so that their enthusiasm will attract others. When this happens, classes will become crowded and new ones must be organized. Devices that have been found useful in popularizing science include science exhibits, science fairs, and science contests.

Effective Learning in the Sciences

R. W. FOGLER

Illinois State Normal University — Normal, Illinois

ONE OF THE most striking paradoxes in American education is to be found in a comparison of the position of science in everyday life and the position of science in the school. In a modern world in the midst of what might be characterized as the age of science, science education has been steadily slipping in its position in the secondary curriculum. To what may this unfortunate situation be attributed? A brief look at what the typical student does in a typical science class may suggest an answer.

Experiment 6

Purpose: To find the other products when potassium chlorate is decomposed.

Materials: The residue left in the test from experiment 5, test tubes, 2 beakers, funnels, ring stand, filter paper.

Procedure: To the residue in the test tube from experiment 5, add hot water, and mix the contents thoroughly. Prepare a filter as directed in paragraph 2, page 10. Wet the filter with hot water; then pour the contents of the test tube upon the filter, catch what goes through in a beaker.

Results: What happens to the liquid?
What happens to the black material?
Why does the filter strain out the black material?
What does the black material look like?

Note: The manganese dioxide causes the decomposition of the potassium chlorate to take place more rapidly when the temperature is low, but it is recovered unchanged. A substance which acts in the way described is called a catalyst. Complete the sentence: In the decomposition of potassium chlorate, manganese dioxide acts as a ______________
Write the equation showing the change.

IS THIS science education? Is it education? Learning as exemplified in the above kind of laboratory work found in most manuals consists of following directions similar to the recipes found in cookbooks. It requires little intelligence to fill in the answers in the blank spaces. All that the student needs to write is what he sees happening. The answer to one of the questions is stated in the exercise and the answer to the last question can be found in a textbook. **A great deal of science is answering questions before they are asked.** If we could get the child back to asking questions, we would be doing something worthwhile.

Learning is more effective if it begins with the problems in which the individual is personally interested because the feeling of interest and of need already is established. The very biological nature of the adolescent involves an increased capacity for physical and mental activity. Workbooks, laboratory manuals and test books hardly satisfy the needs, desires, and problems of students. The science classroom must be a democratic situation where boys and girls are concerned with solving their own problems, co-operating in various group enterprises, and planning the learning for themselves and the group. Most of the formal teaching in a democratic classroom concerns itself with the techniques for promoting self-education rather than the imparting of knowledge about subject matter. Education is not a matter of adding things on as much as it is an enlargement in seeing and feeling.

Every individual is a part of the environment, physical and social. In his reactions to the environment he is constantly faced with the necessity for making adjustments. It would, therefore, seem reasonable that science in the schools should be concerned with problems of adjustment. It should discover the problems and materials not in the pure sciences but in the environment in which the individual is living so that the method for solving problems of the consumer type and the attitude toward the understanding of social physical environment should be developed. The first steps in organizing a science course are those of determining which of the fundamental attitudes toward life and human environment will aid the student to interpret his environment, which ones ramify through his everyday living and

(Continued on page 20)

A Stimulating Biology Club Program

HELEN RUTH GREGORY

Mount Vernon Township High School — Mount Vernon, Illinois

I WOULD FIRST like to assure you that I am not an expert in the science club field. I began the work, as have many others, by searching for, and thinking of, club program material. I did find much that proved quite suitable as was shown by the interest aroused. Our meetings began at 3:30 in the afternoon and many evenings I had practically to shove members out of the door because of approaching darkness. Furthermore, students began waiting to walk home with me, discussing their problems, treating me as a very good friend rather than as just a teacher. They seemed to realize that I was spending much extra time for their pleasure and were quite voluble in their appreciation. I have never found anything else which so creates interest and stimulates learning as did my biology hobby club.

We planned each program around a short business meeting, a report or demonstration by a student, games or group contests, and eats. The first program that I shall describe is Science Solves Crime. The article suggesting the program to me was found in the January 1935 Reader's Digest and was entitled "Science Gets a Confession." Since I'm going to hand out mimeographed sheets giving references for all the programs and descriptions of all the games, you need not try to write them down. After reading the article, I began looking through The Scientific American and Popular Science Monthly magazines for other material along this line. I gathered material for three reports concerning lie detectors, such as truth serum and the psycho-galvanometer, or the Keeler Polygraph based upon the body's physiological and psychological reaction to fear; the microscope an an aid to crime detection; and chemical analysis as a means of solving crime. The first speaker illustrated his talk with things to be observed through the microscope. The report given by the second speaker was suggested by the article, "Blood Will Tell."

FOLLOWING the three talks we had games and contests based on one's ability to solve problems, thus stressing the fact that the detective must be mentally alert and well informed. The first was a puzzle — to seat a rider in corect position upon each of two horses without bending or cutting the cards. I must admit that although it took me quite a while to solve it when first I tried, several of my students solved it so quickly as to put me to shame.

The second game was to test olfactory alertness. How readily do you recognize odors? Each person was given pencil and paper and asked to list numbers from one through eleven. The game chairman then passed bottles, also numbered from one through eleven, around the group. Each bottle contained a strong smelling liquid. Each student was asked to write beside number one the substance he thought bottle one contained. Beside number two he placed his opinion of the content of bottle two, etc. Suitable substances for this test are oil of cloves, essence of peppermint, oil of wintergreen, lysol, ammonia, iodine, formaldehyde, cedar oil, sassafras, etc.

THE THIRD GAME, a group contest, was to solve a chemical unknown. Five or six students made up one group. Each group was given a bottle containing a liquid made up of various substances, such as glucose, peptone, barium, potassium, and a strongly alkaline substance. At each table where a group was to work there were needed test tubes, pipettes, bunsen burners, and various chemical reagents for making the tests. Any member of a group could make a test or make suggestions. The first group handing in the most nearly accurate report was given a prize of a bag of cookies or box of popcorn that the entire group could enjoy.

(Continued on page 17)

The Storehouse of Civilization

C. C. FURNAS

Yale University

New Haven, Connecticut

ALL THAT we are, everything that we have, everything we can ever hope to have, comes from the storehouse which consists of the materials in the thin crust of the earth, in the atmosphere and the streams of radiant energy coming down from the sun. The existence of civilization is dependent upon a continuous supply of these things, and any student exposed to a general science course should leave with the idea that conservation of our resources is a matter of paramount importance to the human race. He should also have that idea that real conservation is wise use rather than mere stinginess or nonuse.

On the basis of probable supply, our resources can be divided into Caesar's convenient classification of three parts:

I. Materials in practically limitless quantities. This class would include air, water, many of the rocks such as granite, sandstone, perhaps limestone, and the radiant energy from the sun.

II. Nonexpendable material in limited quantities. The nonexpendable materials are those that can be recovered after use. This includes most of the metals, in many of their uses, and many of the nonmetallic minerals.

III. Expendable materials in limited quantities. The most notable example of this class is fuel, solid or liquid. From the utilization point of view, fuel is not a material; it is a block of energy. When that stored energy is once used, it is gone forever — to the depths of interstellar space. We won't get it back.

MANY OF the metals and nonmetals are also often expendable, from the practical point of view. Even though they are not gone from the face of the earth, they may be put in such places or be so diluted that they cannot be recovered for reuse. Examples are lead used in house paints, zinc on galvanized wire, arsenic or copper in insecticides, lead and bromine in antiknock gasolines, sulfur in sulfuric acid that is eventually washed down the river.

The conservation problem is quite different for each of the above items. We need never worry about the supply of air. We can use as much of it as we want for manufacturing processes or anything else and harm no one, now or later. But a supply of **pure** air is definitely lacking around some industrial centers. All the air that people breathe or otherwise use is more or less ruined by fumes and dust of every description. The conservation problem there is that of maintaining the local supply of good air by improved techniques, by legislation or by any other available means.

ALTHOUGH there will always be an abundance of water on the face of the earth, there are many areas where there is always a serious shortage. Hence, local conservation (restrictions on unlimited use) are desirable or necessary. An even greater conservation problem is that of limiting the harm effected by water as it runs back to the sea. Soil erosion is a major modern problem, particularly in the United States. It is highly desirable to take all reasonable steps to prevent the unbridled run-off of water, maintain an adequate water level in the ground, and thus aid vegetation. This wisely conserves water and, at the same time, conserves agricultural resources.

The length of life of the nonexpendable minerals, particularly metals such as iron, copper, lead, can be greatly lengthened by reuse or refabrication of the materials after the device in which they are incorporated has run its course. Thus the junk man who collects and sells metal scrap to smelters is a real benefactor to society. His activity should be greatly encouraged.

Another factor of major importance is the substitution of other, more plentiful materials. The potential supply of aluminum is much greater than that of iron. Hence, in the long run, it would be well to use aluminum as a substitute for steel wherever feasible. Although

the tin is often recovered from food containers, the tin supply of the world is definitely limited. It is possible to use an aluminum or even lacquer as a liner for food containers in place of tin. Lending commercial encouragement to this trend would be a real move of conservation. The potential supply of concrete and of some plastic resins is almost limitless. They can often serve as worthy and satisfactory substitutes for steel.

THE THIRD major item in conserving these resources is the development of new techniques of discovery and use. The scientific methods of geophysical prospecting are opening up great deposits of minerals not previously known. Development of improved techniques in the recovery and working of minerals can increase the supply by many fold. This sort of development is going on and must be continued. It can be encouraged by research and by legislation. It is a field of positive action for forward-looking conservation-minded people.

The expendable minerals, or the expendable uses of both metals and nonmetals, present some of our most serious problems. Here the problem of substitute uses can play the greatest role. Zinc is coated on steel for making wire, pipe, gutter pipes, etc., corrosion resistant. The zinc eventually corrodes and is forever lost to reuse. But aluminum is much more plentiful than zinc and can be used for such corrosion protection. Industrialists should be encouraged to make such aluminum coatings commercially feasible. Lead is widely used for house paints, but titanium oxide also makes good paint. The supply of titanium is infintely greater than that of lead. It should be used more.

THE SUPPLY of natural nitrates of the world which are usable for fertilizers is definitely limited. We would now be in an era of serious depletion of natural nitrates if the experimenters of the twentieth century had not perfected the means of making nitrogen compounds from the nitrogen of the air. We are now assured of a supply of nitrogen compounds for all time to come. The invention of nitrogen fixation processes was one of the greatest conservation steps that man has ever brought about.

Our supply of sulfur for sulfuric acid and other compounds is large but definitely limited. In recent years a great deal of sulfuric acid, or even elemental sulfur, is made from the SO_2 of smelter gases. This is a conservation step, but it hasn't gone far enough. We could get all our sulfur at the present time from the sulfur dioxide in the flue gases of our large coal-burning power plants. Steps should be taken to make it commercially feasible to do this.

We use thousands of tons of bromine per year for antiknock gasolines. This bromine is never recovered. But processes are now in operation to recover bromine from sea water. There is enough bromine in the sea to last us millions of years. We don't need to worry about bromine any more than we now need to worry about nitrogen compounds.

THESE FEW items show what an important, and often dramatic, role research and development can play in extending the supply of our expendable materials. It lends hope for the future and puts a positive slant onto the conservation picture, as opposed to the narrow, stingy one of mere nonuse.

Finally, there is the problem of fuel. We are sponging off the solar energy stored up in past ages to the extent of millions of tons of solid and liquid fuels per year. What is being done here? First, industrialists have developed techniques for greatly improving the efficiency of use. This is the wisest and best, not to mention most profitable, form of conservation. Second, many techniques have been perfected for greatly increasing the number of gallons of gasoline obtainable from a barrel of crude oil. The improvements have been almost dramatic. Then great improvements have been made in discovering new deposits. These all stave off the day of depletion of both oil and coal, but they don't eliminate that day from our calendar of the future. Some day these storehouses of fuel will be emptied. What then?

WE CAN ALWAYS use water power. It can be developed to any extent

(Continued on page 28)

Science For Society

EDITED BY JOSEPH SINGERMAN

A department in which science is presented in its close relationship to the individual and in which guidance is given in causing the individual to recognize the methods of science and its vast social implications.

A Ten Million Dollar Doctor Bill

A LARGE portion of our annual national sickness bill of ten billion dollars[1] constitutes one aspect of a scandalous preventable waste. This is just the cold, economic aspect of a big problem, a problem which has its ramifications in human disappointment, misery and heartbreak. It includes the effects of preventable sickness, the application of useless or harmful "curative" measures, and premature death. Dr. M. J. Rosenau, of the University of North Carolina, contemplating the potential blessings of preventive medicine, in a statement to The Science Teacher, writes as follows:

> "Public health, a vital part of the warp and woof of society, needs community co-operation in order to harvest the fruits of preventive medicine. It is closely bound up with problems of social justice. Preventive medicine dreams of a time when there shall be enough for all, when every man shall bear his share of labor in accordance with his ability, and every man shall possess sufficient for the needs of his body and the demands of health. These things he shall have as a matter of justice, not of charity. Preventive medicine dreams of a time when there shall be no unnecessary suffering and no premature deaths; when the welfare of the people shall be our highest concern; when humanity and mercy shall replace greed and selfishness; and it dreams that all these things will be accomplished through the wisdom of man. Preventive medicine dreams of these things, not with the hope that we, individually, may participate in them, but with the joy that we may aid in their coming to those who shall live after us. When young men have vision, the dreams of old men come true."

IS THE WISDOM of man now being engaged to make these dreams come true? Will the vision of young men lead society to a realization of these fond hopes? Paul deKruif looks in upon the scene:

> "Nationwide, with extremely few exceptions, the health departments, hospitals and laboratories of our fighters for life are starved. They are scandalously pinched . . .
>
> " . . . a powerful preventive has been used for whooping cough, chief killer of diseases among children. But for the making and distribution of this life-saving vaccine there is not the money. In other laboratories, hospitals, pathologists and surgeons — operating on the blood vessels of dogs and nervous systems of humans — are finding the cause, making a beginning at cure of high blood pressure which kills thousands of people in the prime of life. Their adventure crawls at a snail's pace. They can't buy enough dogs, or hire enough chemists, or build needed laboratories. So it is on another frontier of human conservation: from certain insanities, disabling nerve afflictions, certain heartwrecks, all sappers of our strength, destroyers of the productive power of the people. Our physicians have not the money adequately to test out the power of the new crystal-pure vitamins against these maladies."[2]

Let us step back and view this picture, with W. T. Foster, from a vantage point. As he points out, we can with our present facilities — without building another hospital, without hiring another doctor — increase health benefits enormously. Foster says:

> " . . . our present facilities, if fully used, would provide nine-tenths the medical care and one-half the dental care which satisfactory standards require, whereas actually we now have only about half the required medical care and only about a quarter the required dental care.
>
> "Yet, even with the present national income (1938.-Ed.), we can afford good care for all our people. Thirty-six dollars a year per person would be enough, if we abolished the reducible wastes of present unbusiness-like methods in the field of medicine. Already we are spending about thirty dollars a year per person."

MEN OF vision set out to do something about this pressing national problem. They brought about the National Health Conference. It opened in Washington, during July of 1938, with

receipt of a message from the President:

" . . . Nothing is more important to a nation than the health of its people. Medical science has made remarkable strides, and in co-operation with government and voluntary agencies, it has made substantial progress in the control of various diseases . . .

"But when we see what we know how to do, yet have not done, it is clear that there is need for a co-ordinated national program of action. Such a program necessarily must take account of the fact that millions of citizens lack the individual means to pay for adequate medical care. The economic loss due to sickness is a very serious matter for not only many families with and without incomes but for the nation as a whole."

What Can Be Done?

MISS HELEN HALL, a national leader among our social workers, has made some interesting observations along this line. In a recent message, she commented:

" . . . the amount paid for medicine — both for prescriptions and for patent medicines—was appalling. (Miss Hall's observations were made among families least able to pay for medical care.—Ed.) One nationally-advertised drug, used by a third of the families interviewed, has been declared by a consumer testing agency not to justify the curative claims made for it, and the Federal Trade Commission has criticized its advertising and insisted upon changes. When I got through seeing that drug pop up, figuratively speaking, on household shelves all over the country, I longed to have the skill and resources of that advertising department turned to the real service and education of the consumer. The consumer has been left far too long to the devices of advertisers, and is sorely in need of systematic education."

That an equitable provision of health measures is a responsibility of the community, has long been established. But, the question of what form this provision should take has provided much material for discussion. The basis of many proposals and counter-proposals may be found in the following comments by Dr. Henry E. Sigerist, of the John Hopkins University:

" . . . no country can possibly escape the trend (to organize medical services.—Ed.) Some people say, however, that this organization of medical services is nothing but the socialization of medicine, and the word socialization is a bogy—it smells of communism. We should not be afraid of the word, but should recognize that the socialization of services is the logical and unavoidable consequence of the industrial development of the world. . . . In the period of transition in which we are living today more and more aspects of our economic life will become socialized, and we have the choice only between two possibilities, either to socialize gradually or to let things go and wait until the pressure becomes so strong that it bursts forth in revolution."

ONLY SOME of the highspots, among the problems of national health, have been but barely scratched. With the accelerated pace at which the nation's military forces are now being built up, ultimate solution of these problems is being further postponed. Subsistence employment through WPA and relief are being drastically curtailed. Newspaper accounts report abandonment of a major portion of an administration health plan which, until a few months ago, it was expected would be enacted into legislation. This plan, incidentally, was an outgrowth of the National Health Conference to which previous mention was made. Nevertheless, as teachers of science — general science, chemistry, biology and physics — our obligation to the needs of our community remains unshaken.

When we teach any subject matter bearing on health, we must make it a definite point to acquaint our boys and girls with the problems concerning national health; they should become literate in an understanding of various proposals for their solution. There are, on this subject, many government reports, inexpensive leaflets, and reference books containing excellent material for student reports and class discussion.

The problems of national health will be solved just as rapidly as, but not more rapidly than the public acquires an intelligent understanding of their nature, and insists on critical evaluation of objectively established facts and principles. The hope of attaining this objective imposes a definite responsibility upon the teachers of American youth. J. S.

1 Who Can Afford Health? Public Affairs Pamphlet No. 27.
2 Toward a Healthy America. Public Affairs Pamphlet No. 31.

Science Clubs at Work

EDITED BY KARL F. OERLEIN

State Teachers College — California, Pennsylvania

A department devoted to the recognition of the splendid work being done by the science club members and their sponsors in the various State Junior Academies of Science. Material for this department, such as student made projects; demonstrations and posters; outstanding club programs; state and regional meeting announcements; should be sent to Dr. Oerlein.

Fly-tying As a Hobby

WILLIAM SUPINA

High School Student

Philipsburg High School — Philipsburg, Pennsylvania

ARE YOU looking for a hobby for the closed season? If you are one of these poor "creatures" called fishermen and would like to put your leisure time in the fall, winter and spring to a good use, try tying your own flies. This is an inexpensive hobby for which, by judicious buying, you can secure the entire outfit for only a few dollars. There are a lot of materials around your own home which can be used, such as wool yarn, silk, tinsel, whiskers from the neighbor's cat, chicken feathers, and so on.

The selection of tools and materials a "feather merchant" needs will include the following: a vise to hold the hooks, sharp-pointed scissors, hackle pliers, tying silk (No. 0000), hooks, wax, hackles, ribbing wire, body material and feathers for the tails and wings. Buying all of these at the beginning will be found to be money well spent.

If you are handy with tools you can save money by making your own vise. I have been getting along with a vise that I made in school. The jaws should be made of fairly hard steel and then case hardened.

Hackle pliers are a very essential tool and are used for grasping the tip of the hackle and winding it on the hook. They work opposite from ordinary pliers in that the handles must be compressed for the jaws to open.

Hooks are a matter of individual preference. For dry flies they should be as strong and light as possible. In the smaller sizes the upturned eye will prove to be best. Naturally, for wet flies the hooks should be heavier in order to secure easier sinking.

Hackles are the feathers found on the necks of game cocks and roosters. They may be procured from the local poultry dealer or may be bought from the dealers of fly-tying materials. If you have the opportunity, buy a live rooster for your Sunday dinner. Skin out the neck, salt, and let it dry. In this way you will have your hackles in order for the various hook sizes. You can also buy whole necks, but they cost as much as a chicken.

FOR MAKING the body of the fly, all kinds of material, such as mohair, floss silk, fur, wool, chenille, raffia grass, cellophane, and the like can be employed; and for ribbing, gold and silver tinsel is necessary. Peacock herl (which is procured from the tail feathers of a peacock) is necessary for many patterns of flies.

Teal, mallard, and barred mandarin duck breast feathers are ideal for tail material as the mottled effect of these fibers closely resemble the segments in the setae of the natural insect.

For the wings of the fly the main flight feathers, known as quill or primaries, are of the most use, and care should be taken that they are exactly matched — that is, one feather is taken from the left and a similar one from the right wing of the bird. Another source of wing material can be found from the breast feathers of ducks. The small feathers are used for fanwings while sections are cut out of the larger feathers and rolled for such flies as require body feather wings.

NOW WE ARE ready to tie the fly, our first attempt being a dry fly. Place the desired size of hook in the vise and break off about fifteen inches of tying silk, which should be well waxed. Lay the tying silk on the shank of the hook,

winding over its own end with a few turns and tie a small weight to the free end of the silk to keep it taut.

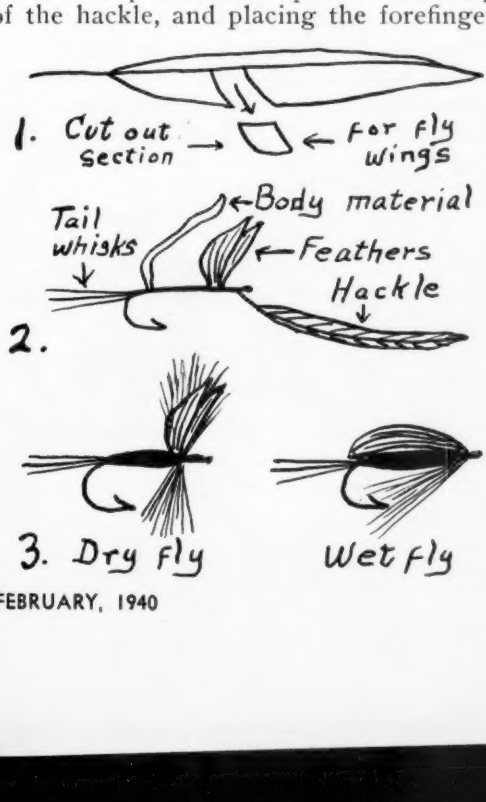
Select a hackle so that the fiber is approximately equal to the length of the hook. Strip off the useless down near the root and tie it on the far side of the shank with the dull or inside of the hackle facing you. (See figure two)

From the two primary feathers or quills cut out sections from each about ¼-inch wide. Place the curved faces together and tie them on the shank of the hook about ⅛-inch back of the eye. Bind down the butt ends of the wings and cut away the useless fibers. Carefully divide the wings with a needle, being careful not to split the fibers. Now pass the tying silk between the wings, and with a figure eight tying, secure in the desired position.

WIND THE tying silk toward the bend of the hook, where the body material and tail whisks should be secured in place with a few turns. Now move the tying silk forward near the eye of the hook, letting it hang.

Grasp the body material with the right hand and wind it on thinly and smoothly, working toward the eye and forming a slight taper. Now with the tying silk bind down the body material and with the scissors cut off the excess end.

Now clip the hackle pliers on the tip of the hackle, and placing the forefinger




Fly tying is an interesting and profitable hobby.

in the ring of the pliers, wind on the hackle clockwise. Fasten the tip of the hackle with a few turns of the tying silk. Procure a piece of thin cardboard about an inch square and punch a hole in the middle with a needle. Run the free end of the tying silk through this hole, grasp the end to keep it taut and slip the cardboard over the eye of the hook.

The beginner will find it easier to finish the fly with a half-hitch. Make two or three of these and clip off the excess end of the tying silk. Put a drop of liquid lacquer on the head; remove the cardboard and the fly is finished.

WET FLIES are tied in a similar manner. First the hackle is tied on the far side of the hook with the glossy or outside fibers facing you. Then the wings, concave faces together, are tied on with the tips of the wings out over the eye of the hook. The fly is now built up step by step, similar to the dry fly. After

(Continued on page 26)

We would like to have pictures of student science exhibits presented at state or sectional meetings of the Junior Academy of Science of each state. Here is an opportunity for those interested in photography.

Chemistry and Criminal Investigation

CAPTAIN JOHN T. TAYLOR

Ft. Wayne Police Department — Ft. Wayne, Indiana

IN A STUDY of modern methods of criminal investigation in the National Police Academy at Washington, District of Columbia, I found that chemistry plays a very important part in criminal investigation.

In many cases the chemist in the crime laboratory, with the assistance of the investigator, solves a crime, points to a suspect, or guilty party, or forces a suspect to confess to a crime committed without ever having been near the scene of the crime or knowing who the suspect might be. The investigator needs no actual knowledge of chemistry, but he must be able to recognize the many kinds of evidence found at the scene of a crime which require chemical analysis. It is his duty to find the evidence, protect it and send it to the laboratory, explaining the type of examination he desires. He must then collect all other evidence that may be of value in interpreting the findings of the chemist.

For instance, in a recent murder case in Fort Wayne, a piece of paper was found at the scene of the crime which appeared to have on it a stain, possibly semen, and also appeared to have an outline of a fingerprint. In this case we had to decide which would be the most valuable to our case as evidence. The chemical process used to develop the fingerprint would destroy the examination for semen, or vice versa. We chose the examination for the fingerprint.

AMONG CHEMICAL tests used, the Benzidene and Percipitin tests for blood are very helpful. A solution of benzidene in grain alcohol added to glacial acetic acid and used with three per cent peroxide will serve as a field test to determine whether or not a stain is blood. This test can be applied to any object, even soil. If it is found to be blood, it then is necessary to determine if it is human or animal blood. This is determined by the Percipitin test, but it must be performed by a trained chemist. The human blood can be further examined for particular groups. Research work along that line may be of great value to the investigator in the future. At present blood cannot be traced to any one individual.

Many other chemical analyses have proven of value to law enforcement work, such as examinations of dyestuffs, paints, stains, and powders in narcotic investigations. Chemicals are also used in cases involving theft of money. A certain chemical placed on the money will stain the hand of the party that touches the money, making it impossible to remove the stain for a long time.

The gun powder test is used to determine if gunpowder is present in the hand of a person suspected of having fired a gun or in the hand of a suicide. With this test a paraffin mold must first be made of the hand and then a diphenyl-amine solution is dropped into the mold. If a particle of nitrate is present the solution will cause the nitrate to turn a purple color.

THE DRUNKOMETER is becoming more popular daily and is used in cases of drunken driving or where a suspect in some crime claims to have been intoxicated at the time of the crime. It will also show that some people who have had only one or two drinks are not intoxicated. Chemical tests of the breath of the suspect, obtained by having the suspect blow his breath into a toy balloon will show the exact amount of alcohol in the system and a table compiled by the inventor, a chemist, will show whether the suspect has more alcohol in the system than can be consumed normally.

Truth serums, more or less in the experimental stage, are used in questioning suspects.

A chemical solution is now used to bring out secret writings, invisible inks. In one case it brought out a perfect fingerprint on a newspaper eighteen years old. Iodine fumes are used to detect fingerprints on rough objects.

Polaroid Material and Its Uses

KENT H. BRACEWELL

Hamline University St. Paul, Minnesota

This article is a continuation of the material presented in the December, 1939, issue of *The Science Teacher*, under the title "Polarized Light."—The Editor.

SOON AFTER the polaroid material had been developed and thoroughly tested, Land and Wheelwright decided to organize a company to develop and market the new product. I am told that their primary idea was to induce the automobile industry to install a section of the film in each headlight of the cars and another section in the windshield set with its axis parallel to that of the sections in the headlights. Such a system would allow the light from one's own headlights to be reflected back through the windshield, but would remove the glare from a similarly equipped car coming from the opposite direction.

At present, when two cars with normal lights meet at night, the lights of the approaching car completely blind the other driver. However, when the cars are equipped with polaroid, not only is the glare of the approaching car reduced, but you can actually see the section of road immediately ahead of the car, and also a man on a bicycle at the edge of the road, a figure which is normally quite invisible.

While the Polaroid Company has been chiefly interested in inducing the automobile industry to equip cars with polaroid, more than 800 other uses have been found for the product. Time will permit a discussion of only a few of the most significant ones.

It has long been known that ordinary light is partially polarized by reflection, when the angle of incidence is within appropriate limits. The plane of vibration of the polarized reflected light is horizontal and since it is, for the most part, the polarized reflected beam that produces the glare, the glare can be removed by polaroid sun glasses set to extinguish horizontal vibrations.

IT HAS LONG been known that glass under strain becomes highly colored when viewed with polarized light. Here are two specimens of glass that have been improperly annealed. When viewed normally they seem to be ordinary pieces of glass, but when polarized light is used, they appear highly colored. This fact is used in testing large blocks of glass used in giant telescope lenses and mirrors. The entire block of glass is examined, bit by bit, in this manner. If any part of it shows color, the glass is under strain and is unfit for use. If it is badly strained, it might explode while being ground. Even if the latter misfortune did not occur, it would gradually change its shape in time and ruin it as a perfect optical instrument. Certain other materials than glass exhibit the same characteristics. Notable among these is transparent bakelite. It is now a rather common engineering practice to build miniature models of huge engineering structures out of these plastics and subject them to forces proportional to those in the actual structure. The strained sections exhibit color bands, and scientists have learned to correlate the degree of coloring with the extent of the strain. In this manner, it is possible to tell whether the design is correct or not before a single piece of steel has been laid. In particular, I believe that Boulder Dam was so examined in miniature. It is interesting to know what a small amount of polaroid was necessary for the task.

MENTION previously was made of the fact that in doubly refracting crystals, the E beam travels with a different velocity than does the O beam. Hence, one beam will emerge ahead of the other. If such a crystal is inserted between two polaroids, the crystal will be colored, the type of color depending upon the nature of the crystal, the thickness of the crystal and the orientation of the polaroids. If, for a given wave length, one beam emerges a half wave length ahead of

(Continued on page 27)

National Committee on Science Teaching

Here are given the names of members of the National Committee on Science Teaching and also questions individuals or groups may study. Answers can be mailed to the men indicated and should reach them by February 20th Credit will be given for any material used. This is a democratic undertaking.

Martin V. McGill is the Chairman of the Division of Chemical Education, American Chemical Society. Address Martin V. McGill, Chairman Sub-Committee on Evaluation of Methods of Science Teaching, Lorain High School, Lorain, Ohio.

Dr. Ralph S. Powers is Chairman of N. E. A. Sub-Committee on Teacher Training. He should be asked for a copy of the questionnaire the committee is using. His address is Teachers College, Columbia University.

Sub-Committee on New Materials— E. S. Obourn, Chairman, John Burroughs School, Clayton, Missouri.

1. What types of New Materials are most needed by science teachers?
2. In what ways can the science committee help in having new materials prepared and made available for general use?
3. Other suggestions.
4. Names and addresses of teachers really interested in developing new materials.

Sub-Committee on the Philosophy of Science .Teaching. Nathan A. Neal, Chairman, James Ford Rhodes High School, Cleveland, Ohio.

1. Do boys and girls, through their experience in science classes, achieve desirable attitudes and methods for living in a democracy which they could not achieve otherwise; if so, what are they?
2. Is critical thinkig the chief intellectual need of a democracy? Assuming that it is, does science teaching promote critical thinking through the scientific method?
3. Is it important to place great emphasis on the role of science within the process of social dovelopment? Should the part played by individual scientists within the process be emphasized?
4. How may students be encouraged to recognize which influences in the world make for permanence, and which make for change? Does adherence to fixed habits of thought or action make the consequences of change more painful?

Sub-Committee on the Personal and Social Needs of Children. W. C. Croxton, Chairman, State Teachers College, St. Cloud, Minnesota. Please list the needs, interests and abilities of pupils at the following levels: kindergarten and pre-school, primary grades, intermediate grades, junior high school, senior high school, and junior college for the following areas: recreation and satisfaction; health, safety and the ability to do useful things efficiently; social attitudes, social action and habits of service to society; more comprehensive and reasonable outlooks based on scientific concepts; development of scientific attitudes and understanding the scientific method.

Sub-Committee on Evaluation: Carleton E. Preston, Chairman, University of North Carolina, Chapel Hill, North Carolina. Mr. McGill's study described in this material is being made as one of the projects of the Evaluation Sub-Committee.

1. Has the time come to break down more compartmental walls and make a further approach toward an integrated (unified) and regularly progressing science program in senior high school as well as in grades below? Illustration: Subtitute for separate physics and chemistry a combined two-year study of matter and energy changes, of difficulty commensurate with that of present physics and chemistry.
2. We profess to be interested first in the development of children and young people in terms of abilities, skills, attitudes. To what extent is it (a) desirable, (b) feasible to conduct at this time an elaborate analysis of the mental operations involved in acquiring and weighing knowledge — in school and out —

(Continued on page 29)

BIOLOGY CLUB

(Continued from page 7)

When first we organized the club I asked all of those wanting to do microscopic work to gather in one corner. Those desiring to work with plants were directed to another corner. A third group chose chemical experimentation and a fourth asked to do dissection work. We then tried to arrange programs suitable for each group and to allow time for work along each chosen field. The program introducing amateur microscopy is the one I want to describe next.

FOLLOWING the report by a student, I gave a demonstration of how to wall in protozoans that they might more easily be studied. Perhaps you've used this method for years, but for a long time I unsuccessfully followed the procedure given in most laboratory manuals, that of putting a few strands of cotton upon the slide to trap the tiny organisms. My trouble was that they would nose under the strands, becoming wholly or partially obscured from view. One day while trying to show some students how to draw dye under a cover glass with a blotter to stain some protozoans, I noticed that the organisms had moved away from the dye to a clear area on the slide where the dye had not yet spread. It occurred to me that it ought to be possible, with practice, to put the dye upon the slide in such a way as to leave a tiny spot of just one field in the center unstained but completely surrounded with dye, so that they would flee to that spot. I tried it, and that was actually what happened. Moving to that field I found many organisms milling about, unable to leave the field without running into the offending dye. If one is very successful in the attempt, they will be so numerous as to remain comparatively quiet even under high power.

After the report and demonstration the pupils were divided into three groups. One group, made up of those who had never studied pond water, was allowed to view through the microscope the organisms described in the report. Of course, we had previously made sure that these organisms were available. Another group, made up of those who had previously studied pond water, worked at tables, practicing walling in protozoans. The third group, which also had previously studied pond water, wandered around the room looking at various books and magazine articles available as reference material.

FOLLOWING our study of animal classification, we planned a program around the topic "Animals," that the students might have a chance to make practical use of some of the scientific terms learned. The reports were about prehistoric animal life. When I visited the Chicago World's Fair I brought back a pamphlet from the exhibit "The World a Million Years Ago." It contained colored pictures of prehistoric animals and a colored chart showing the geologic eras of time. We also had in the library a book, "Prehistoric Animals," by Raymond Ditmars illustrated by Helene Carter. The students making the report added to this source material the Sinclair Oil Company's booklet and stickers of colored prehistoric animal pictures. Using an opaque lantern which reflects colored pictures upon the screen, he gave an illustrated talk.

Also several students had made soap models of prehistoric animals; so these were displayed to the group.

Next, a girl read several selections from Maynard's collection of evolution poems. I haven't time fully to discuss these or to read them in their entirety. The poem, "Similar Cases," by Charlotte Perkins Gilman, begins with the evolution of the horse thus:

"There was once a little animal
No bigger than a fox,
And on five toes he scampered
Over tertiary rocks.
They called him Eohippus
And they called him very small,
And they thought him of no value
When they thought of him at all."

Then the author brings the horse up to its present-day development, and further discusses dinosaurs, anthropoidal apes, and Neolithic man.

The other poem is one that is more familiar to most people, and one which I like because it enables the student to follow the animal classification from lower to higher chordates and to recognize the geologic eras of time. It is

Continued on page 24)

SCHOOL HEALTH EDUCATION

(Continued from page 3)

council, which group he serves in an advisory capacity. This person should be a school man in every sense of the word, trained in the health-medical sciences as well as education. He should be given full responsibility for co-ordinating the joint efforts of each respective health-contributing gency or department.

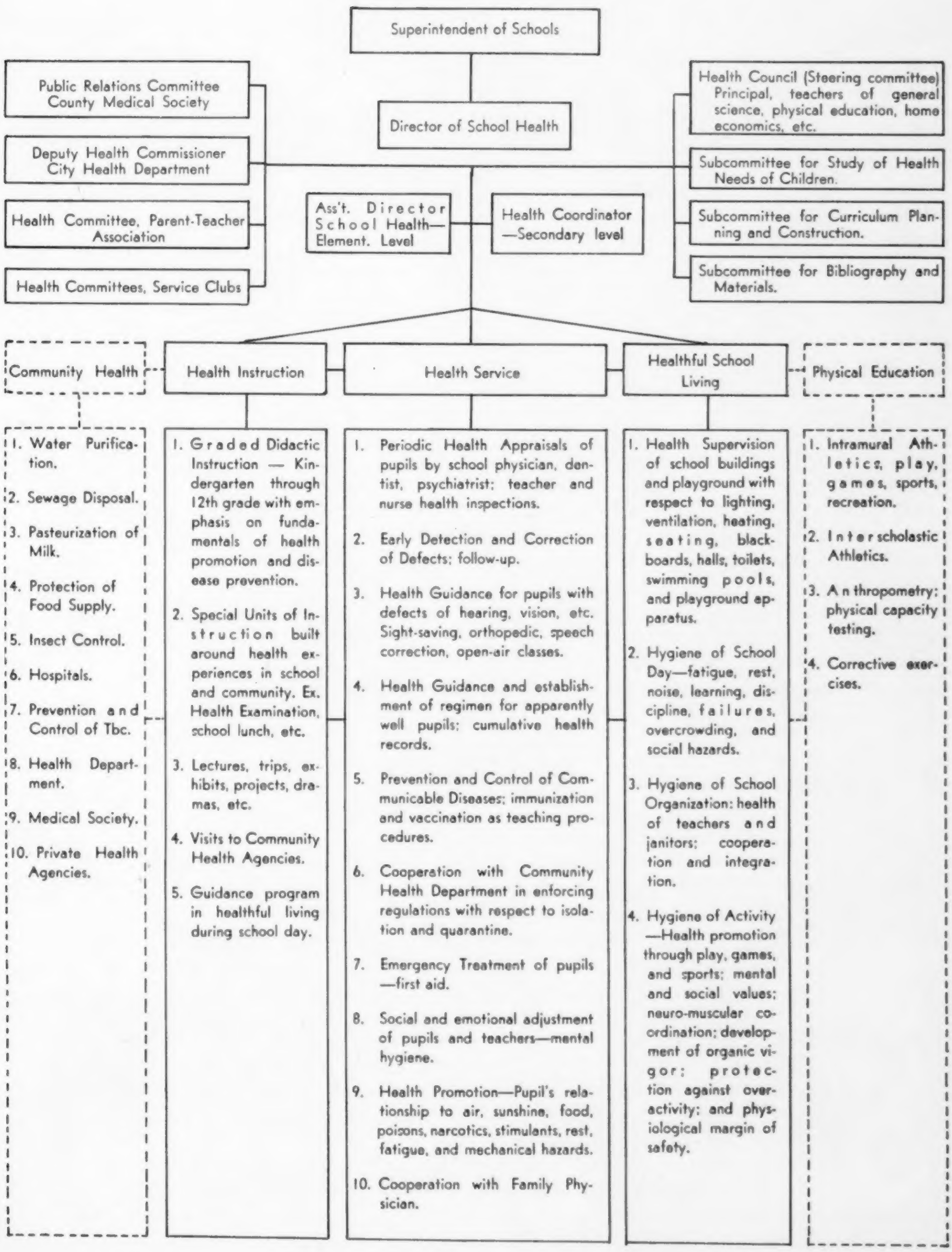
5. **Trained Personnel.** It is essential that all school health educators including teachers, nurses, nutritionists, physicans, and most important, the administrators, receive adequate training in school health education as is now provided at the several schools of public health. Certainly, the scientific viewpoint will never prevail as long as school people continue to resort to ill-founded advice emanating from self-made health educators. They need, instead, to think for themselves.

6. **Health, the Fundamental Issue.** Health is recognized today as equal in importance to any of the other objectives of secondary education. From an administrative standpoint, the writer believes it is important enough to exist as a single functional entity. By this the writer does not have in mind a departmental organization. The term, School Health Education Program, serves very adequately to describe the nature of the total program. While some educators may still believe that health education should be joined with other already accepted programs, as for example, Health and Physical Education, the writer is of the opinion that we might with equal justification associate it with home economics, physiology, biology, or other subjects which contribute in part at least to the health objective in education.

7. **Home and School Co-operation.** It must be recognized that parents have the primary responsibility for their children's health whether they are in school, on the street, or at home. Both home and school have important parts to play, however, in motivating children so that desirable forms of health behavior re-

(Continued on page 32)

FUNCTIONAL PROGRAM OF SCHOOL HEALTH EDUCATION
(Secondary Schools)



Prepared by Earl E. Kleinschmidt, Chicago, Illinois.

EFFECTIVE LEARNING

(Continued from page 6)

which of the skills are essential for learning life adjustments. The skills that are useful in obtaining solutions to problems are those pertaining to reading, laboratory work, mathematics, analyzing, verifying, reasoning, inferring, and many others.

IT HAS BEEN recognized by science teachers for a long time that science has a contribution to make to the individual through the knowledge that is classified as science, but in most cases this knowledge has been presented for its own sake with little consideration of its functional value in living. If the science program in the secondary school is going to contribute to the education of boys and girls in a democracy, it is essential that it makes some provisions for teaching boys and girls how to solve problems confronting individuals in adjusting to the varied responsibilities they must assume as active participants in a community.

Science then has two general objectives to realize if it is to contribute to the education of boys and girls in the secondary school. First, science should develop functional understanding that will help the individual make satisfying adjustments to self-personal adjustment, to the immediate social group, to the community, and to economic relationships. Second, science should develop the individual's ability to consciously use the problem solving method, which includes the development of scientific attitudes and the ability to use the skills involved in problem solving.

THE TECHNIQUES involved in problem solving cannot be realized incidentally. We have fooled ourselves long enough in this respect. This fallacy was developed by those who did not know how to go about teaching the techniques of problem solving. Definite techniques are involved; teaching must be deliberately directed toward their development.

The steps or elements of problem solving have been stated in various ways, but when comparisons are made, the methods are found to be similar. For the purpose of showing how these steps may be realized in unitive planning, the steps of problem solving may be listed as follows: (1) Recognizing and formulating the unit problem; (2) analyzing this problem into subordinate problems; (3) gathering data for each of the subordinate problems; (4) analyzing and synthesizing of the data relative to each of the subordinate problems; (5) formulating a hypothesis or tentative conclusion to each of the subordinate problems; (6) verifying the hypothesis; (7) stating the conclusion for each of the subordinate problems; (8) formulating a conclusion to the unit problem, based upon conclusions developed relative to the various subsidiary problems; and (9) applying the conclusions to concrete situations.

Before a student can plan a unit of learning, he must select a problem. The problem that he selects should be one in which he has a definite interest, and not one that is imposed upon him by the teacher. This does not mean that the teacher has no responsibility in the student's selection of a problem. Certain students, if left to work by themselves, will fail to recognize significant problems. The teacher, in such cases, must guide the students so that an interest may be developed in problems of significance.

THE PROBLEM should be a clear and concise interrogation relating to one important idea. This idea must be one that contains a broad and comprehensive relationship. The problem must challenge the student to become active toward a solution of it. If the unit problem survives this evaluation, it must then be analyzed into the subordinate ideas involved in it. These become the basis for the formulation of the subsidiary problems. The subsidiary problems should satisfy the standards used in evaluation of the unit problem. Each should involve one important phase of the unit. They should be arranged in an order that will logically develop the solution to the unit problem.

The next step to be taken in solving the unit problem is the gathering of data or collecting the information that will solve the subsidiary problems. The teacher at this point should spend some time with the group getting suggestions

from them as to the methods they can follow to get the information needed. The following activities are suggestive of different methods: Reading as an activity used to solve problems will include the reading of textbooks, reference books, books of a popular nature, magazines, newspapers, bulletins and any other material that will give the student the information he needs to solve his problem. The student may observe natural phenomena, institutions, processes and activities, controlled experiments, and visual materials to obtain evidence that will contribute to the solution of his problem. Interviews with individuals who are authorities or who have had experience with the problem will prove a valuable source of information. Discussion of the problem with other members of the class, with the teacher, with his parents and with associates outside of school will provide additional data. Further information may be gathered from reports given by different members of the class relative to the problem under consideration. Debates on questions involved in the problem aid in clarifying controversial issues. The student may obtain additional information or verify evidence already obtained by experimenting with various factors involved in the problem.

Different individuals learn best by various activities. They vary in their ideations. One person may learn best by reading, by discussing, by observing, by interviewing, or by a combination of two or more of the various activities. The student should be given opportunity to select, for the purpose of gaining information, those activities in which he is most interested and which he is capable of doing.

THE STUDENT under the guidance of the teacher should prepare his own study guide. He is, by this means, planning the activities that will guide him in his learning. He is developing the techniques of planning that are ordinarily monopolized by the teacher. No plan is a good plan unless it is definite, complete and well formulated. The student in making his study guide must realize that fact from the beginning. If he is planning to observe, as one of his activities, he should state the name of the book and the part he plans to read. The plan that the student develops to guide him should be definite, complete and practical. The student by this procedure is performing the activities that have long been done for him. He is developing insight, initiative and the ability to direct himself.

There are certain techniques that students must develop in gathering and recording the data or information they obtain from the various activities. After the data has been gathered and recorded, some organization must be made. This is the next step in problem solving, the analysis and the synthesis of data. Analysis consists of going through the data recorded and selecting the important ideas. The importance of any fact recorded will depend upon its pertinence to the solution of the problem at hand. This student in his analysis must also develop the ability to evaluate his data. This evaluation should be made not only in the terms of pertinency but also in sufficiency.

THE NEXT STEP in problem solving is the statement of a tentative conclusion or hypothesis to the problem. This hypothesis is a generalization based upon the statements developed in the synthesis and involves the techniques for generalizing. This technique can be taught and must be mastered by the student before he can think in terms of relationships rather than in terms of isolated facts. The hypothesis must be verified. The student must obtain from further sources information that will confirm the statement he made as a hypothesis. This might be done by applying the tentative conclusions to concrete situations, by reading, observing, interviewing, or any of the other activities in gathering data.

When the hypothesis has been verified, it becomes the conclusion to the problem. In order that this conclusion may be related to the organized past experiences of the student, he must select from his experiences certain situations to which his conclusion will apply. This last step in problem solving is the vital one if individual's behavior is to

(Continued on page 28)

BIOLOGY CLUB

(Continued from page 17)

by Langdon Smith, entitled "When You Were a Tadpole and I Was a Fish."

WE HAD NO trouble finding suitable games for this program; rather, we had difficulty deciding which to use. The first we chose was a crossword puzzle designed to use such terms as entomology, protozoans, anthropods, paleontology, etc. The second contest was a modeling contest. All members had been asked to bring a package of chewing gum to this meeting. After giving a piece of cardboard and toothpicks to each person the chairman gave directions to chew the gum, place the gum upon the cardboard and, using fingers or tothpicks, model the animal that he had assigned to each There were judges and a ten-cent store animal prize was given for the best work.

The third was a group contest. Each group was made up of about ten or twelve members. An animal such as dog, cat, giraffe, or elephant was assigned to each group, which was collectively to draw a picture of the animal assigned to it. Each member must participate by drawing a line not longer than two inches. There must be no erasures and each individual was allowed only one line. The group having the best finished drawing was given a box of animal crackers.

THE PLANT experimentation group had a somewhat varied program — as follows: first, they had leaf print demonstrations of five types, namely: spatter prints; blue prints; those made with water color paints, construction paper, and printer's roll; those made with photographic paper; and leaf models made of plaster of paris and colored. Following the demonstrations those wanting to try making leaf prints were allowed to do so under the direction of the demonstrators. Another troup exhibited material to show the stimulating effect of auxilin upon root growth of geranium cuttings. One girl had an especially fine terrarium made by bringing soil in from the woods in February. It contained a Jack-in-the-Pulpit and various

other plants. Nature magazines, "Better Homes and Gardens," and the Leisure League Hobby Book, "A Garden in the House," were references for this group.

The last program that I shall describe was also our last meeting of the year. The yearbook had just been distributed and the students were madly gathering autographs and souvenirs. Thus it occurred to me that the girls, at least would like to have something to remember the club by. So I planned a souvenir meeting. I was a little afraid of the boys' response, but it turned out that they were even more enthusiastic than the girls. I purchased penny balloons to be strung around the walls and had two boys come down to my room the last period of the day to put them up. When they rubbed the balloons against their wool trousers and touched them to the wall, they stuck there. The room looked quite festive. As the members began to arive, the game chairman met them at the door, pinning to the back of each the name of a noted scientist, such as Louis Pasteur, L. O. Howard, E. V. McCollum, Thos. Hunt Morgan, Anton van Leeuwenhoek, John Jacob Abel, etc. They were asked not to talk until all were assembled. When ready, the game chairman instructed them that each was wearing the name of a noted scientist, and that each could discover the identity of the name he wore by asking questions of neighbors and friend.

I know that most people, even adults, think that a party isn't a party without refreshments. I wanted my students to enjoy the learning process, and I honestly believe that my biology club members did.

The success of a science club depends upon the interest and enthusiasm of the instructor sponsoring it. He will build his programs around his own interest fields using available material. The student response is gratifyingly easy to maintain. The club will carry itself after initial plans are disclosed and the primary organization is perfected. I believe that most of the biology club members agreed with the writer in the October, 1937, Readers Digest who said, "Staying after school is fun."

FLY TYING

(Continued from page 13)

the hackle is wound on, the wings are folded back and lashed down in the required position. (See figure three.)

Select a remote corner of your home for this work, where mother will not "raise the dickens" because of the dirt you make. Be careful to keep your feathers where the moths will not get into them.

I hope you will find fly-tying as interesting and profitable a hobby as I have. Within the past two years I have made many extra dollars by selling flies which I have tied in my spare time.

AND NOW a few words on imitating stream insects. Artificial crane fiies are ordinarily tied on long-shanked hooks and with hackle-point wings. The six long legs on the natural insect can be imitated with fibers secured from the tail feathers of a large bird. Tie two knots in each to represent the joints.

Flies, like the bee, should be dressed with a heavy chenille body. The wings should lie flat and the legs are probably best imitated by hackle stems, the fibers cut close on both sides to give a fuzzy appearance to the legs.

The quill-bodied flies are constructed from the quill obtained from the eye of a peacock tail feather. Detach a fiber from the eye and remove the flue, either by pulling it between a pair of tweezers or by the following method. Grasp the piece of herl in the right hand and lay it on a smooth surface. Now with the right hand press the needle over it, and pull the herl from under the needle. The smooth section obtained is wound on the hook in even, uniform spaces.

Now after your start in fly-tying you can expect to be given names as "Sut Tattersul," the feather merchant, as I was given. The local fishing clan is merciless. You will find, however, that the results you obtain, after your first few "attempts" will be well worth the time spent, both in money earned or saved, and in the thrill of getting your first "big ones" on flies you have made yourself.

POLAROID MATERIAL

(Continued from page 15)

the other, then by means of the second polaroid, destructive interference can be obtained. If white light is used, this one wave length only is destroyed, while the others are transmitted in varying degree. But when one color is extracted from white light, the balance is colored. Such colors are very delicate and beautiful. They should not, however, be confused with colors produced by passing white light through colored glass. To illustrate this theory, I have a thin quartz wedge. When viewed with plane polarized white light, the wedge is crossed with successive rainbow bands, the bands, of course, being parallel to the thin edge, for all points in a given color band represent the same crystal thickness.

Here again, may I refer to the rose and butterfly patterns mentioned earlier. The explanation of the color formation is now clear. The sections of one color represent one thickness of crystal, those of another color have a different thickness. A slight rotation of the polaroid changes each color to its complement.

THE MOST beautiful phenomenon in the entire physical sciences is perhaps the formation of doubly refracting crystals in polarized light when viewed through a microscope at low power. One of the most beautiful of these crystals is acetamide. Plates of these crystals may be easily prepared for observation. They are formed by melting a small quantity of the crystals on a glass plate. When covered with a second plate and allowed to cool, crystallization sets in rapidly. The crystals are quite clear, but when seen with polarized light they are most beautifully colored. The different colors represent different thicknesses of crystalline film. Bertillion experts tell us that no two people have the same finger prints. So also, no two of these figures are alike. You could observe these plates by the thousand and no two would be alike.

STOREHOUSE OF CIVILIZATION

(Continued from page 9)

that does not seriously spoil natural beauty. But that will supply only a fraction of our necessary energy. Eventually we must perfect means of utilizing the streams of energy coming down from the sun. We will never run out of this, for as much energy falls on the earth in one minute as the entire human race utilizes in one year. The problem of this utilization has not even been attacked yet. It offers a fascinating field for future chemists and engineers.

This very sketchy review surveys what I consider to be the background of a very essential part of any general science course — that of the wise use of the material resources of civilization. You don't need to use the word **conservation.** That usually has a very negative, gloomy, stingy connotation in the average mind. Put the whole subject on a positive plane. We can have all the materials and energy we want or can use, practically for all time to come, if we harness our ingenuity to solving the multitude of problems which come up. The boys and girls now taking general science are the ones who are going to be busy solving the maze of scientific, technical, and social problems involved in the coming generations. If the average pupil (male or female) doesn't find it a highly interesting field of study I have a grave suspicion that it is the presentation rather than the subject which is uninteresting.

EFFECTIVE LEARNING

(Continued from page 22)

be affected by these new experiences.

IT IS NECESSARY that the student develop certain fundamental attitudes before he can effectively use the steps in problem solving. Before the individual can recognize problems, he must develop a curious and critical attitude toward the things that are happening around him.

The local market with thousands of products offers a challenge to each individual as a consumer. Buying, one activity which everyone does day after

day all through life, demands a critical attitude on the part of the consumer if he successfully combats the propaganda with which he is faced through the medium of papers, magazines and the radio. The function of science is to develop the ability in the individual to solve the problems that confront him, and the consumer problem is an ever growing one. Since problems of social significance must be encountered in the secondary school if such problems are to be solved by the future generations, the third year science course in University High School is built around the individual as a consumer and the problems he will meet in carrying out life's various activities.

In a later article an attempt will be made to show how science may function in helping students to make necessary adjustments and how teacher-pupil planning with real problems of the pupil are worked out in classroom.

NATIONAL COMMITTEE

(Continued from page 16)

into such relatively simple factors that each can be identified and (a) separately measured, (b) assigned to proper difficulty level and to appropriate subject matter for development, (c) cultivated through specifically designed techniques? For the development of which mental operations has science the major responsibility? Are there any for which it has the sole responsibility? (This matter of analysis would seem to have wide possibilities of usefulness in connection with (a) the study of integrating the program, (b) remedial teaching after diagnosis, (c) measuring both results of teaching and mental aptitudes, (d) guidance and placement.)

3. Should a similar analysis be made of specific attitudes and their degrees of attainment?

4. Just what do so-called "achievement tests" measure, if anything at all specifically and accurately?

BOOK SHELF

Physics Workbook. Mahlon H. Buell, Department of Physics, Senior High School, Ann Arbor, Michigan, and Frederick W. Schuler, Department of Physics, West High School, Madison, Wisconsin. J. B. Lippincott Company, Chicago, 1939. 378 pp. 190 illustrations. $1.00 list price.

This new Physics Workbook by Buell and Schuler is a combination text, problem book and laboratory manual written to save the student's time and guide him with a minimum of effort to the mastery of the principles of physics. The supplementary material is not sufficient to render a text unnecessary, but it conserves the student's time, unifies the work, and makes the work book easy to use with any standard text or a series of texts.

The course is organized into eleven units with an introductory unit on measurement. Unit one deals with the molecular nature of matter and unit eleven with radiation.

The latter introduces the vacuum tube in relation to radio and talking moving pictures. It also includes infra red and ultra violet rays, X-rays, radio activity, and cosmic rays. There are 52 unit problems, 57 experiments, and 46 suggested demonstrations.

Experiments and demonstrations are planned for simple, inexpensive type of apparatus. There are page references to nine standard high school physics texts given with each unit.

The work book is planned to give a practical physics course that covers the essential principles and at the same time directs the student to see the relationship to life situations. In fact, the unit problems to a great extent present the material in a setting of everyday use or of historical development or both. The exercises are particularly of a practical nature.

Each unit begins with a suitable preview and closes with a series of unit activities including projects. The student self-tests at the end of the unit cover the essential points that have been studied. Unit Tests, Form A and Form B, are supplied separately with the workbooks. A Teacher's Answer Key is also provided.

Excursions in Science. Edited by Neil B. Reynolds, special writer for General Electric Company, and Ellis L. Manning, Supervisor of Science, New York State Department of Education. Whittlesey House, a division of McGraw-Hill Book Company, New York, 1939. 307 pp. $2.50 net.

In Excursions in Science are presented thirty-five different phases of science selected for their special appeal to popular interest, and particularly well suited to the interests of students in both the junior and senior high school. The material presented is drawn from all the sciences and embraces such widely diverse topics as "Atoms and their Family Relations," "Lilliputian Chemistry," "Heredity," "Science and Superstitions," "How Your Radio Tubes Work," "Time," and "Where Human Energy Comes From."

Each topic discussed is in fact a little excursion in the field of science and give the reader not only some understanding of the science involved but presents it in its close relationship to the environment of the individual. The reason for the clear cut and interesting presentation is no doubt due to each topic being presented by a scientist who has been specially trained in that field and who in many cases has made it a hobby or a part of his daily work. Thus thirty different scientists in all have contributed to this interesting book.

Among the contributors are such well-known men as Dr. Irving Langmuir, famous for his work in electronics and surface films; Dr. Katherine Blodgett, recognized for her work on invisible glass; and Dr. Karl B. McEachron, who has accomplished much in the study of lightning.

The book has been developed from the material presented in radio broadcasts sponsored by the General Electric Company and embodies a selection of the best of these popular presentations.

Excursions in Science definitely leads to understandings in science areas that are challenging to people, gives insight into the methods of research, shows how scientists not only find out the why and wherefore of things but also how they set about making use of their knowledge for the advantage of man; indicates for future generations some of the knotty

problems that yet remain to be solved.

The Why of Qualitative Analysis. Alfred M. Ewing, Texas Wesleyan College, Ft. Worth, Texas. Published by the author, 1937. 43 pp. Many diagrams. $1.00 net.

The Why of Qualitative Analysis by Professor Ewing, is designed particularly for college freshmen chemistry students to give them a clearer understanding of what is happening as each step of the qualitative analysis procedure is carried out, and to give a simple mental picture of the scheme of analysis. The book is also adapted to the use of advanced and more capable high school students who desire experience in qualitative analyis as a chemistry project or advanced work.

The book is unique in that the plan of analysis is indicated by a series of diagrams (e.g., a funnel is used to indicate filtration) that help the student to get a mental picture of the procedure. With each diagram is indicated the test to be used and the possible results. The diagrams provide the background for making effective the accompanying questions and answers applying to the procedure. A complete chart giving the diagrammatic scheme of analysis of all five groups is also included.

The most important feature of the book is the questions raised about every step in the procedure and the clear-cut answers given. There can be no doubt but that a student who will think through the process as directed by these questions will be a more intelligent and efficient workman. He will be in a position to judge the amount of chemicals used in any step or the amount of washing required without relying on a fixed, rule of thumb procedure The questions and answers are arranged on the page adjoining the diagram of analysis, thus enabling the student to visualize each step as he does his thinking.

The book, being intended for the first year chemistry student, is not extensive in content, but is complete as far as it goes. Sufficient directions are given to acquaint students with the qualitative analysis procedures of first year's work.

In addition to the scheme of analysis some attention is given to the theory underlying it. A number of useful tables are also included.

The author makes no claim for originality in the material presented. However, the results to be obtained through its use in terms of understanding and intelligent use of chemicals and apparatus together with the saving it may bring in the instructor's time and energy recommends its use in any beginning study of qualitative analysis.

SCHOOL HEALTH EDUCATION

(Continued from page 18)

sult. Each is singularly helpless without the full co-operation of the other.

8. **Co-operation with Community Health Program.** The director of school health education should work closely with the public relations committees of the medical society, the community health department, the parent-teachers' association, and the service clubs. In this way the community as a whole is kept aware of child health needs.

9. **Channels for Administrative Action.** All school health problems should be dealt with through the regular channels already set up for obtaining administrative action. Moreover, every activity engaged in by health workers should have the full and unqualified support of the school administrator. An informed administrator will usually take full responsibility for what is done and stand back of the program.

10. **Unity of Action.** All parts of the program should operate as integrated parts of a single co-ordinated whole. It follows also that each part should be kept fully informed of the efforts made by other parts of the total program.

Conclusions

Attention is invited to the inadequate organization of many school health education activities found in the schools today. In view of the marked overlapping of function, uncertainty with respect to responsibility, and general lack of coordination, the writer is of the opinion that drastic reshaping of the program is in order. An administrative plan of action is suggested which the writer believes should lead to the development of a well-integrated school health education program.